Examiners' Report

IGCSE Chemistry (4335)

June 2006

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Examiners' Report

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CHEMISTRY 4335, CHIEF EXAMINER'S REPORT

Paper 1F, Section A

Questions in this section are targeted at grades E, F and G.

Question 1

This question was designed to test candidates' knowledge of the Periodic Table. Most scored well on this question with no parts proving to be more demanding than others.

Question 2

This question was designed to test candidates' knowledge of atomic structure.
Most candidates scored all three marks available for labelling the diagram of the atom. A few candidates miscalculated the mass number of the atom, either by counting all of the particles or by counting only one type of particle. One or two candidates were confused by (a)(iii), since no atom with this atomic mass is shown on the Periodic Table provided. However, candidates are expected to know that it is the atomic number that determines which element an atom is. In (b), some candidates got the protons and neutrons the wrong way round. One common error was to say that isotopes of the same element had different **relative** atomic masses - this must be wrong since the relative atomic mass is the average atomic mass of the atoms of an element allowing for the abundance of each isotope.

Question 3

This question focused on the reaction of magnesium with sulphuric acid.
In giving observations, it must be remembered that if a colourless gas is produced, then the gas cannot be seen (and so saying "a gas is made" is not a correct observation and so does not score). What is seen are bubbles or effervescence and we conclude that a gas is being produced. Likewise, we can not see the metal dissolve – what we do see is the lump of metal get smaller; in any case 'dissolve' is not a correct term here, since if the metal were dissolving we would have a solution of magnesium produced – dissolving is a physical process and this is a chemical reaction. With gas tests, the general rule is that if the test is wrong then no marks can be awarded for the result. Hence if the test is given as 'apply a glowing spill', no mark will be awarded for the result of the test, since an incorrect test has been used. Part (c) was testing candidates' knowledge of factors that change the rate of a reaction. Many candidates selected incorrect choices and full marks were not as common as expected.

Question 4

In (a), candidates were required to complete the table to show whether a substance was an element or a compound, and to state the type of bonding in that substance. The first column of the table, as expected, proved to be straightforward, since if a substance is an element it will be found on the Periodic Table provided. More errors were evident in the bonding column, with the main error being the assigning of hydrogen chloride as ionic. Many candidates failed to score in (b), with some giving two isotopes in (ii). In (c), candidates were expected to draw a diagram of an electric circuit. Many of the diagrams seen suggested that candidates were not familiar with testing the conductivity of a solution. All that was required was a power supply (such as a cell or battery), something to detect a flow of charge (such as a light bulb) and a complete electric circuit with electrodes dipping into the solution. Many simply left this blank or drew circuits which were little more than wires or electrodes dipping into the solution.

Candidates were not expected to know the correct symbols for items in the electronic circuit, but they are advised to label apparatus so that the examiner can give full credit for their knowledge. The observation had to be linked to the circuit drawn – if a light bulb was not in the circuit then credit could not be given for saying the bulb lights. Few correct answers were seen for (c)(ii) – near misses such 'electrolysis' were seen, but could not gain a mark since this is the process and not the name of the solution.

Question 5
This question dealt with organic chemistry.
Part (a) was generally well answered, but candidates should be reminded to look carefully at the wording of the question; if the question asks for **one** substance then giving two is not a good idea, since if the extra substance given is incorrect no mark can be awarded as the wrong answer negates the correct answer given. Part (b) was often correct, but some candidates then did not read (c), and gave the general formula for an alkene rather than for compound C; some candidates gave the molecular formula of compound C. The remainder of the question, with exception of the formula mass determination in (f), was very low scoring. The organic chemistry of this course, even at Foundation Tier, is not restricted to hydrocarbons.

Question 6
This question was based on a reaction scheme for copper compounds.
In (a), most candidates scored well, although (aq) was sometimes given as aquatic (which has a rather different meaning) and some thought that (s) stood for solution. Part (b) was very poorly answered with most candidates picking up zero marks, or one mark (that being for (iii) – although even here some candidates thought that **W** must be the symbol of the gas and so claimed it was tungsten). Candidates often failed to name nitric acid correctly, with answers based on nitrate or oxides of nitrogen not being uncommon. Part (d) proved more rewarding for many with the reaction products often correct, although nitrogen dioxide was rarely seen in (e). Candidates had more success with working out the acid was sulphuric acid.

Paper 1F, Section B / Paper 2H, Section A

Questions in this section are targeted at grades C and D.

Paper 1F Question 7 / Paper 2H Question 1
This question was based on the elements in Groups 1 and 2.
Few candidates had difficulty with (a), although in (b)(i) some candidates ignored the instruction and tried to give a symbol equation; in a few instances the gaseous product, hydrogen, was missing. In (b)(ii), the required observations were things that could be seen, a colourless gas cannot be seen being given off, the observation is bubbles or effervescence; other neutral answers (ones that did not gain credit but were not deemed to be wrong and so did not cancel out a correct observation) included 'dissolving' (since this can not be seen, and sodium solution is not the product) and 'flame' (since a small piece of sodium on water will not ignite unless it is restrained in some way). Part (c)(i) caused some students problems: some described the use to which litmus is put, but did not use the all-important word 'indicator'; those who added 'pH' or 'universal' to indicator did not gain the mark since litmus does not indicate pH. In (c)(ii), some students hedged their bets and gave the colour in both acid and alkali. Two answers, one of which is wrong, will never gain credit in this type of question. Parts (d) and (e) were well answered with a minority of candidates having the hydroxide as the product in (d)(i).

Paper 1F Question 8 / Paper 2H Question 2

The majority of this question tested candidates' knowledge and understanding of the preparation and properties of carbon dioxide.

Part (a) was well answered by most candidates, although some tried to add the solid through the tap funnel. The method of gas collection expected was the use of a gas syringe. 'Downward delivery' or 'upward displacement of air' were also accepted, but some candidates got these two names mixed up and gave answers such as 'downward displacement of air'; some candidates gave two contradictory answers and so failed to score. Part (c) was very poorly answered: a common error was to see the word 'acid' in the introduction and so say the indicator turned red, whereas carbon dioxide is only a weak acid. Candidates are advised to give only **one** colour in answer to this sort of question – if they give two (or more) colours than ALL must be correct to score the point. In (c)(ii), a common error was to focus on the hydrochloric acid and not on the required product of the dissolution. Part (d) was nearly as often wrong as it was right – suggesting a degree of guesswork rather than trying to use the information provided on melting points. Most scored in (e), but in (f) many candidates incorrectly focussed on the fact it was impure rather than on the fact there was very little of it. A few candidates seemed concerned that removal of carbon dioxide from the air would kill plants! In these days of the enhanced greenhouse effect, students would be expected to know that **increasing** carbon dioxide levels are thought to be a problem.

Paper 1F Question 9 / Paper 2H Question 3

This question was about the industrial separation of crude oil.

It proved to be low scoring for the majority of candidates. Most scored the first two marks but the remainder of (b) often yielded only one further mark. Many gave a mathematical or dictionary definition of a fraction rather than linking it to the stem of the question which was about fractions of crude oil. Very few correctly stated that a fraction was a collection of compounds with similar boiling points. There was a confusion between the industrial and laboratory process in (b)(iii). This question required the industrial process in which the oil is heated (not burnt as some candidates claimed) prior to the vapour being passed into a fractionating tower. Some candidates made life a little easier for themselves by drawing a diagram which made it clear that the fractions were obtained at different levels. The main problem in (c) was in (iii), where candidates gave the names of fractions already given (paraffin, for example, is kerosene). Part (d) provided a happier ending to the question for most candidates. Carbon monoxide as the product was well known and some detailed explanations were seen in (d)(ii). However, it should be noted that carbon monoxide does not destroy haemoglobin or cells: it can, however, lead to death and this simple statement was missing from many answers.

Paper 1F Question 10 / Paper 2H Question 4

This question was about aluminium.

Very few good answers were seen in (a), although almost no candidates were able to state that the cryolite acted as solvent. The mark for reducing the melting point **of the mixture** or lowering the temperature required to conduct the process were given more frequently. Some students referred to boiling points, and others seemed to think that cryolite was a coolant since it cooled the process down – neither of these approaches gained credit. While many students scored well on (b), many scored poorly; incorrect electrode materials were often seen (aluminium being common). It should be noted that the gas produced by electrolysis is not carbon dioxide – this is made by oxygen reacting with the carbon of the anode. Some misconceptions were evident in (b)(iii)- the electrodes need to be replaced due to a chemical reaction in which they are used up to make carbon dioxide; the electrodes are not worn away (this is a frictional process) nor are they eroded or eaten.

Imprecise answers also cost some candidates marks in (c). The important point is that aluminium is **more reactive** than carbon – saying that aluminium is very reactive is insufficient. Some answers to (d) incorrectly focused on various costs (such as the need to obtain cryolite). Those who chose to use replacement of the electrodes as a reason needed to specify that it is the anodes that are replaced (since the cathodes are not replaced frequently). All that was required in (e) was to relate the uses of aluminium to its properties. This proved unexpectedly difficult. Two important points to note are firstly, that since only iron can rust any answer stating that aluminium did not rust (rather than did not corrode) was incorrect; and secondly that aluminium is not a **light** metal - the mass also depends on how much you have – it has a **low density**. A variety of odd answers were seen - a number of candidates suggested that aluminium was used for power cables because it did **not** conduct electricity!

Paper 2H, Section B

Questions in this section are targeted at grades A*, A and B.

Question 5
Part (a) required candidates to write a chemical equation with state symbols. Many candidates ignored the instruction to include state symbols and a large number of others used monovalent magnesium in the equation and so were unable to score any marks. Where state symbols were included, common errors included stating HCl was a liquid or that $MgCl_2$ was a solid. Most candidates managed to score some marks when drawing the sketch lines on the graph. While the relative gradients of the lines were usually correct there were more problems with predicting the final volume of gas collected. Line B very rarely indicated that the final volume of gas would be half that shown by the printed line. Most candidates managed to gain at least one mark in (c), although it was common for candidates to claim that atoms or molecules were moving faster, rather than **ions**: in this situation it is safer to use the general term <u>particles</u>. Part (d) required a chemical test for chloride ions. Tests for chlorine gas were depressingly frequent and performance was rather centre dependent.

Question 6
This question was based on chorine.
Very few candidates knew the metal from which the anode is made, so they guessed. Sadly, when guessing they did not use their chemical knowledge and so common answers were: sodium (which would react with the water, or the chlorine produced); carbon (not a metal) and chlorine (neither a metal nor a conductor). Many candidates were able to state that electrons were responsible for the conduction in a metal, but very few gave the names of **both** ions responsible for the conductivity of the brine – candidates should look at the number of marks available to help them in this sort of situation. Part (b) was concerned with the chlorination of an alkane. Few candidates could recall the need for uv light to initiate the reaction. To answer (b)(ii) and (iii), candidates were expected to use the information in the equation provided and realise that Cl_2 and HCl would both change the colour of blue litmus - it was not uncommon for the two observations to be the wrong way round. Some excellent calculations were seen in (c). Where a candidate failed to obtain the correct answer, credit was given for evidence of some correct working. However, credit for correct working can only be given if the examiner can follow what has been done – spaces filled with seemingly random calculations with no indication as to what the candidate thought they were doing failed to score. Some candidates had the empirical and molecular formula the wrong way round.

Question 7
This question was designed to test candidates' knowledge and understanding of the chemistry of ethanol.
Most candidates scored well in (a), though some chose to use methods of production other than the two given in the introduction. Part (b) elicited very few correct answers: what should have been straightforward recall of reagents proved beyond the knowledge of most candidates. The best candidates scored full marks when drawing the polymer structure, although a common error was to add a hydrogen atom to one of the oxygen atoms making it either trivalent, or converting it into an alcohol group. Part (c) (ii) required the name of the type of polymer: trade names (such as Terylene) were not credited.

Question 8
This question was about the extraction and uses of metals.
While many candidates scored both marks in (a), a number wrote equations which did not involve carbon at all. The two balanced symbol equations in (b) proved to be very difficult for some candidates. Of the two equations, the first one was most often correct. Many candidates then chose to make something other than iron in the second equation – oxides of iron or oxygen gas were not unusual products. Some excellent answers were seen to (c) with some very logical structures: those who did not know the chemistry involved often picked up a mark for forming slag. In contrast, (d) was probably the worst answered question on the paper. The extraction of zinc is on the specification and so the provided data should have been an additional aid to candidates. However, it was evident that very few candidates either knew the process of extracting zinc in a blast furnace, or how to use the data. All that was required was an understanding that the temperature in the blast furnace was above the boiling point of zinc, but below that of silicon dioxide (the main impurity); as a result the zinc evaporates leaving the impurities behind. Part (e) proved to be more difficult than expected; some candidates claimed that 'zinc rusted instead of iron' – since only iron can rust, this statement is incorrect. The correct answer is 'zinc corrodes instead of iron', which should then have been linked with the idea that zinc is more reactive than iron and that the iron will not rust. Some very bizarre answers were seen: some candidates thought zinc had a low density and so it helped ships float, while others thought zinc had a high density and so it acted as a ballast to keep the ships upright.

Question 9
This question was based on the chemistry of copper.
In (a), a common error was to give the name of the species that had been oxidized, rather than the oxidising agent. Candidates were expected to use the equation to help, the expected answer being Cu^{+}, although copper(I) oxide was also accepted. The observations in (b) were not well known. Many stated that a blue colour would be seen but did not gain the mark because they did not specify it would be the solution as opposed to the solid or a gas. The reaction of copper with concentrated nitric seems to be unfamiliar to many students – a common error was (correctly) to state that there would be effervescence, but then incorrectly to call the gas colourless (hydrogen); it is worth noting that while 'gas produced' is not an accepted observation for the production of a colourless gas (since the gas cannot be seen, its production is concluded from the fact that effervescence is seen) here stating 'brown gas made' is accepted as an observation since the gas can be seen.

Many candidates gained full marks for the calculation in (c), while others picked up some credit for correct working. As in Q 6(c), credit for correct working can only be given if the examiner can follow what has been done. Common errors included not converting the time to seconds and not using the equation to see that the ratio of moles Cu: moles electrons was 1:2. In (d), students were expected to explain why metals are ductile or malleable (based on the layers of atoms being able to slide over each other) and then to use the diagram provided to work out why alloys are harder to deform. Answers that implied the random motion of particles did not gain credit.

Question 10

Some candidates failed to attempt (a): this can only be due to not reading the examination paper with sufficient care. The calculation in (b)(i) was often very well done, with the most common error being the final subtraction of energies, where candidates got the numbers the wrong way round. As a general rule, there will not be any marks for units in calculations unless the units are specifically asked for. However, the inclusion of incorrect units will mean that the final answer is wrong and so a mark is lost – in this question a number of candidates claimed their answer was in joules rather than kilojoules. The energy level diagram in (b)(ii) was a good discriminator: some candidates left it blank or rewrote how they worked out the answer to (i). Amongst partially correct answers, a common omission was not to label the vertical direction as 'energy' or to label the enthalpy change incorrectly on the diagram. Descriptions of how to conduct a titration in (c) were very poor. Most candidates scored 1 or zero marks. The following should be borne in mind:

- The volume of acid used was 10.0 cm^3 and so this solution should be placed in a conical flask; its volume should be measured with a pipette since a measuring cylinder is not sufficiently accurate for titration work.
- The volume of sodium hydroxide used was 16.70 cm^3 and so it must have been in the burette. There is no problem with using dilute alkalis in modern burettes since they have Teflon taps. Using the alkali in the burette gives a better colour change for phenolphthalein indicator.
- An indicator is required. If one was named it had to be an acid/alkali indicator, and a correct colour change was required at the endpoint. Universal Indicator is not suitable for titrations since it does not have a sharp colour change at the endpoint.
- The solution in the burette should be added slowly near the endpoint (not all the way through). Only candidates who wrote about doing repeat runs tended to score this point.

Some candidates clearly did not read the question and filled the space with a moles based calculation based on the volumes and concentrations given the question. Some of these candidates then failed to attempt the calculation in (d). The titration calculation was often well done: common errors were to fail to convert the volume from cm^3 to dm^3 or to make an error with the magnitude of the answer.

Paper 3

General Comments

Questions in this paper are targeted at full range of grades from A* to G.

Question 1

This question was designed to test candidates' familiarity with common examples of laboratory apparatus and their uses. High scores were expected, and few candidates lost more than 1 or 2 of the 7 marks available. Common errors included naming the pipette as a burette, and using the gas syringe to measure the volume of a solution. The main cause of lost marks was the fractionating column, partly due to a poor diagram, which is regretted.

Question 2

In (a), the safety precaution hoped for was one specific to the corrosive nature of sodium hydroxide, so general precautions such as "wear a lab coat" or "tie your hair back" were not accepted, although "wear eye protection" was. The burette readings in (b) were generally correct, with only a minority reading the scales upwards instead of downwards, or writing the readings in the wrong boxes. In this particular question, although the liquid levels were actually on the 0.1 cm^3 divisions, candidates should remember that they are expected to read to the nearest half-division, so it is good practice to quote values such as 20.20 rather than 20.2 (as shown in the table in (c)). In (c), very few candidates seemed to be familiar with the concept of concordance in burette readings, which in this paper means that readings should differ by no more than 0.20 cm^3. Every possible combination of ticks was seen, with the ticking of the last three being the most common (perhaps on the assumption that the first result will be inaccurate, or perhaps because this was the only one beginning with 28, rather than 27). Some candidates failed to place ticks as requested, but were able to score this mark when their choice was clear from their subsequent working in calculating the average. A small minority of candidates seemed unable to calculate an average from their ticked results correctly.

Question 3

The vast majority of candidates correctly calculated the mass and percentage in (a). Part (b) was also well answered, with the commonest error being to state that crushing the rock salt would make more dissolve. Quite a few candidates wrote about the reaction, instead of the dissolving being faster, although this was not penalised. Very few candidates scored all 3 marks in (c). Quite a number got no further than just weighing, with many of these failing to score because it was not clear what was being weighed. Others repeated the method shown in the diagrams.

Question 4

The use of a polystyrene cup in (a) elicited a surprising variety of responses. Although many correctly mentioned its insulating properties, some went on to suggest that the glass beaker would break because of the great heat, while others thought that the polystyrene cup prevented the reactants from attacking the glass. A few claimed that as the polystyrene cup could be thrown away it would avoid having to wash the glass beaker! The thermometer readings in (b) were generally correct, with errors similar to those found in the burette readings in Q 2. The drawing of the two-line graph in (c) will have been unfamiliar to most candidates, and it is pleasing to report that so many produced excellent lines that scored all 4 marks.

The weakest candidates plotted 12 points instead of 6, or drew curves that started at 15°C, or had lines curving towards each other rather than crossing. Some of the general errors common to all graph-plotting questions were seen, such as misreading the scales, using large blobs for points, or drawing multiple lines. Most who succeeded in (c) had little trouble in (d), although some misreading of scales was again in evidence. Most candidates mentioned repeating in (e), but this response did not score unless it was related to the volumes in (d). A pleasing number of candidates gave a correct reason for their choice of potassium hydroxide in (f).

Question 5

Part (a) was generally correct, with just a few candidates giving the depth of liquid, or of liquid-plus-foam. Relatively few candidates scored full marks in (b). Quite a number of points were misplotted, and the drawing of the smooth line of best fit was poorly done. Identifying the features in (c) proved a challenge for candidates, and full marks were rare, with the weakest scoring only with temperature. A minority thought that the other metals should be in the same group of the Periodic Table as magnesium, or that they should have the same reactivity. Perhaps the most common unacceptable answer was that the masses of metal should be the same, rather than the number of moles. Although hardly any candidates mentioned moles, those who wrote "amount" scored because this term has the meaning of amount in moles. Common acceptable answers were that the metals should be powdered like magnesium, that the same volumes of acid-plus-detergent should be used, and that the proportions of acid and detergent should be the same. The full range of marks was seen in (d), but there were many common errors. These included identifying Metal 5 as having the most reliable results because it had the most results, rather than Metal 2 (where there were 4 results much closer together). The anomalous result (105) stood out from the others, but even so was often inadequately identified just as Student S or Metal 3, rather than as a combination of the two. The most reactive metals were frequently taken as the two with the longest times, rather than those with the shortest times. Many of those who made the correct identification gave as their reason that there was a result missing, rather than that the results were similar.

COURSEWORK (PAPER 4), PRINCIPAL MODERATOR'S REPORT

General Comments on Science Coursework

The coursework component is only available to centres which are recognised by Edexcel as International Teaching Institutions.

The number of students entered for this component of the iGCSE examination was as follows:

Code	Subject	Number entered in 2006	Number entered in 2005
4335	Chemistry	193	79

All of the centres that entered students for this component of the examination had their science coursework moderated by Edexcel's co-ordinating Principal Moderator for GCSE. The moderating instrument used was the Sc1 criteria as used by Home centres, using exemplars provided by the JCQ (Joint Council for Qualifications) as a guide. Centres entering students for the coursework component of the iGCSE examinations in 2006 therefore had their coursework moderated to the same standards as for all Home centres.

Chemistry 4335

The most common task seen this year was a rates task – almost invariably sodium thiosulphate / hydrochloric acid.

This is a very common task in UK centres, but it does have some disadvantages. Firstly, if the students (or teacher) decide to investigate the effect of varying the concentration of sodium thiosulphate solution, it is difficult for the students to incorporate sufficient scientific knowledge to access P8a fully. It is more appropriate to study temperature as the variable, so that students can discuss exo- and endothermic steps, as well as the concept of activation energy.

Centres who awarded full marks for the visual disappearance of a cross in the thiosulphate / acid task were too generous. The observation of a cross disappearing as the precipitate of sulphur forms is a subjective matter, and therefore lacks precision. (Precision is a key factor in the award of O8a). Please note also that the requirements of O6a and O6b must be fully met before an award of O8a is considered.

Students who choose to investigate the effect of varying temperature on the reaction rate should be encouraged to record the actual temperatures used. Quoting the temperatures to the nearest ten degrees (perhaps following the range of temperatures stated in the planning phase) lacks precision, and such students had their marks reduced in consequence.

Most centres did use the approved annotation method when marking scripts, but one centre used an inappropriate method of awarding marks after every paragraph written by the students.

CHEMISTRY 4335, GRADE BOUNDARIES

Option 1 : with Written Alternative to Coursework (Paper 3)

	A*	A	B	C	D	E	F	G
Foundation Tier				54	44	35	26	17
Higher Tier	75	62	49	36	25	19		

Option 2 : with Coursework

	A*	A	B	C	D	E	F	G
Foundation Tier	No candidates this session							
Higher Tier	75	63	51	39	28	22		

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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